SMPTE OVERVIEW

12G-SDI Bit-Serial Interfaces — Overview for the SMPTE ST 2082 Document Suite

Document Overview

The SMPTE ST 2082 suite of documents defines the mapping of various source image formats onto a single-link, dual-link and quad-link serial digital interface operating at a nominal rate of 12 Gb/s. This informative “roadmap” describes the documents in the SMPTE ST 2082 suite.

The SMPTE ST 2082 series specify a common virtual interface that is carried on electrical physical interfaces which are also defined in the document suite and on optical physical interfaces.

The diagram of Figure 1 illustrates a simplified ‘Image mapping data flow’ roadmap for the 12G-SDI profile as defined by the ST 2082 document suite. The individual roadmaps of the SMPTE ST 2082 standards include additional details of reference standards.

Approved May 2, 2018

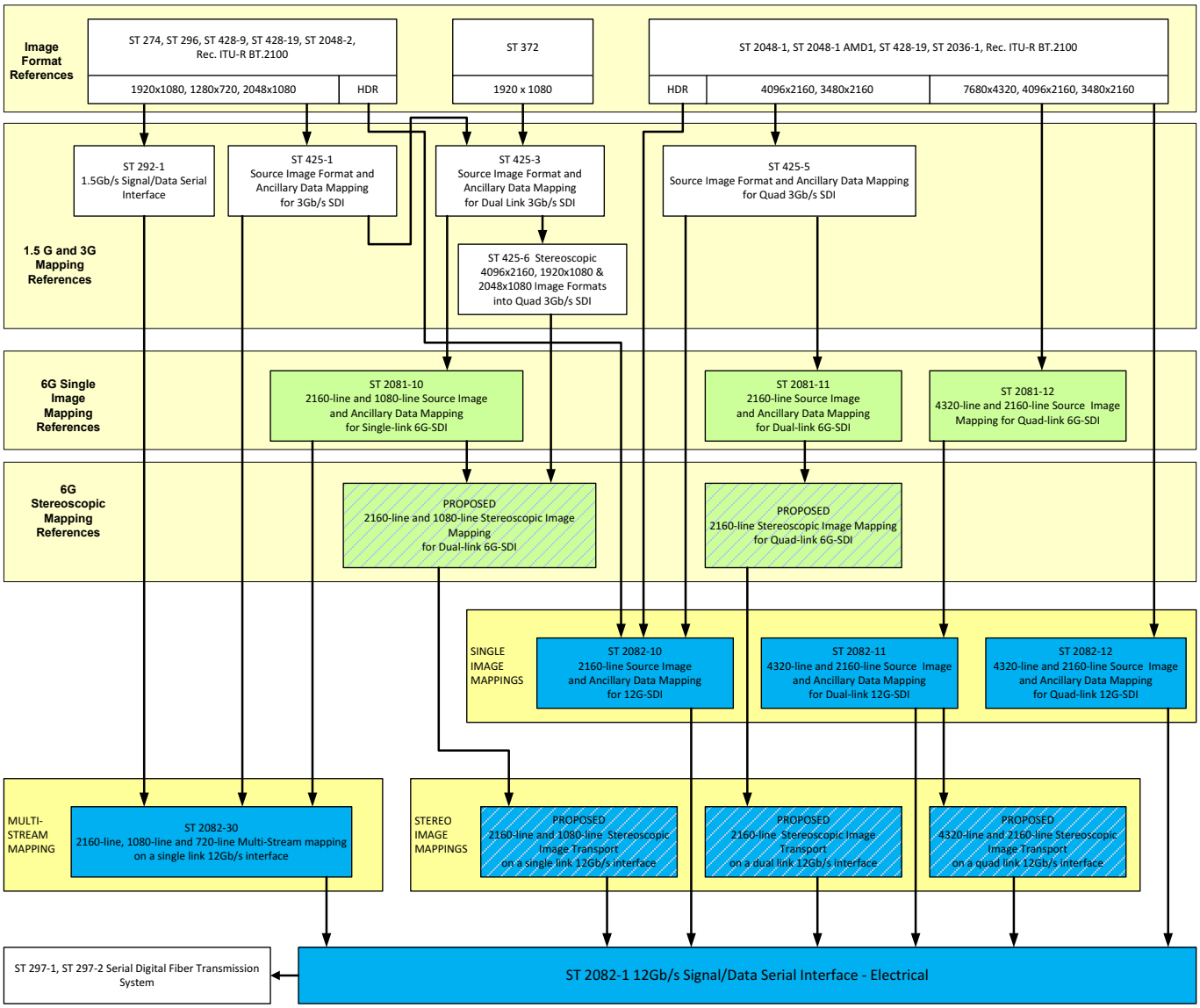


Figure 1 – 12G-SDI Profile

1 SMPTE ST 2082-1 – 12 Gb/s Signal/Data Serial Interface — Electrical

This standard defines a bit-serial data structure, electrical signal and coaxial cable interface for the transport of signals with a total payload of 11.88 Gb/s or 11.88/1.001 Gb/s.

This standard also specifies the electrical and physical characteristics of coaxial cables and connectors.

2 SMPTE ST 2082-10 – 2160-line and 1080-line Source Image and Ancillary Data Mapping for 12G-SDI

This standard defines the carriage of 2160-line and 1080-line image formats and associated ancillary data into a Single-link 12 Gb/s [nominal] SDI bit-serial interface as follows:

- **MODE 1:** 2160-line Standard Dynamic Range (SDR) and High Dynamic Range (HDR) Source image formats and ancillary data into a 12G-SDI 10-bit interface as defined in section 6 Single-link 12G-SDI 10-bit Multiplex
- **Mode 2:** 1080-line High Frame Rate (HFR) Standard Dynamic Range (SDR) and High Dynamic Range (HDR) Source formats and ancillary data into a 12G-SDI 10-bit interface as defined in section 6 Single-link 12G-SDI 10-bit Multiplex

This standard also defines the carriage of the SMPTE ST 352 payload ID's for the single-link 12Gb/s SDI interface.

2.1 SMPTE ST 2082-10 Supported Image Formats

UHDTV1 and 4K Digital Cinematography Production, SDR and HDR			
Reference Standard	**Image Format**	**Signal Format Sampling Structure/pixel Depth**	**Frame Rate**
SMPTE ST 2036-1 Rec. ITU-R BT.2100	3840 × 2160	4:2:2 (Y′C′$_B$C′$_R$)/10-bit 4:2:2 (IC$_T$C$_P$*4)/10-bit, 4:2:0 (Y′C′$_B$C′$_R$)/10-bit 4:2:0 (IC$_T$C$_P$*4)/10-bit	50, 60/1.001 and 60 frames progressive
SMPTE ST 2048-1	4096 × 2160*2	4:2:2 (Y′C′$_B$C′$_R$)/10-bit	48/1.001, 48, 50, 60/1.001 and 60 frames progressive
SMPTE ST 2036-1 Rec. ITU-R BT.2100	3840 × 2160	4:4:4 (R′G′B′)/10-bit 4:4:4:4 (R′G′B′+A*3)/10-bit	24/1.001, 24, 25, 30/1.001 and 30 Progressive
SMPTE ST 2048-1	4096 × 2160*2	4:4:4 (R′G′B′)*1, 4:4:4:4 (R′G′B′*1+A*3)/10-bit	
SMPTE ST 2036-1 Rec. ITU-R BT.2100	3840 × 2160	4:4:4 (Y′C′$_B$C′$_R$)/10-bit 4:4:4:4 (Y′C′$_B$C′$_R$+A*3)/10-bit 4:4:4 (IC$_T$C$_P$*4)/10-bit 4:4:4:4 (IC$_T$C$_P$*4+A*3)/10-bit	
SMPTE ST 2048-1	4096 × 2160*2	4:4:4 (Y′C′$_B$C′$_R$) 4:4:4:4 (Y′C′$_B$C′$_R$+A*3)/10-bit	
SMPTE ST 2036-1 Rec. ITU-R BT.2100	3840 × 2160	4:4:4 (R′G′B′)/12-bit	
SMPTE ST 2048-1	4096 × 2160*2	4:4:4 (R′G′B′)*1/12-bit	
SMPTE ST 2036-1 Rec. ITU-R BT.2100	3840 × 2160	4:4:4 (Y′C′$_B$C′$_R$)/12-bit 4:4:4 (IC$_T$C$_P$)*4/12-bit	
SMPTE ST 2048-1	4096 × 2160*2	4:4:4 (Y′C′$_B$C′$_R$)/12-bit	
SMPTE ST 2036-1 Rec. ITU-R BT.2100	3840 × 2160	4:2:2 (Y′C′$_B$C′$_R$)/12-bit 4:2:2 (Y′C′$_B$C′$_R$+A*3)/12-bit 4:2:2 (IC$_T$C$_P$*4)/12-bit 4:2:2 (IC$_T$C$_P$*4+A*3)/12-bit	

		4:2:0 ($Y'C'_BC'_R$)/12-bit 4:2:0 ($Y'C'_BC'_R$+A*3)/12-bit 4:2:0 (IC_TC_P*4)/12-bit 4:2:0 (IC_TC_P*4+A*3)/12-bit	
SMPTE ST 2048-1	4096 × 2160*2	4:2:2 ($Y'C'_BC'_R$)/12-bit	
SMPTE ST 2048-1	4096 × 2160*2	4:2:2:4 ($Y'C'_BC'_R$+A*3)/12-bit	
HFR HDTV and 2K Digital Cinematography Production, SDR and HDR			
Reference Standard	**Image Format**	**Signal Format Sampling Structure/pixel Depth**	**Frame Rate**
Rec. ITU-R BT.2100	1920 x 1080	4:4:4 (R′G′B′)/10-bit 4:4:4:4 (R′G′B′+A*3)/10-bit 4:4:4 ($Y'C'_BC'_R$)/10-bit 4:4:4:4 ($Y'C'_BC'_R$+A*3)/10-bit 4:4:4 (IC_TC_P*4)/10-bit 4:4:4:4 (IC_TC_P*4+A*3)/10-bit	120 frames progressive 120/1.001 frames progressive 100 frames progressive
SMPTE ST 2048-1	2048 x 1080*2	4:4:4 (R′G′B′*1)/10-bit, 4:4:4:4 (R′G′B′*1+A*3)/10-bit, 4:4:4 ($Y'C'_BC'_R$)/10-bit, 4:4:4:4 ($Y'C'_BC'_R$+A*3)/10-bit	120 frames progressive 120/1.001 frames progressive 100 frames progressive 96 frames progressive 96/1.001 frames progressive
Rec. ITU-R BT.2100	1920 x 1080	4:4:4 (R′G′B′*1)/12-bit, 4:4:4 ($Y'C'_BC'_R$)/12-bit 4:4:4 (IC_TC_P*4)/12-bit	120 frames progressive 120/1.001 frames progressive 100 frames progressive
SMPTE ST 2048-1	2048 x 1080*2	4:4:4 (R′G′B′*1)/12-bit, 4:4:4 ($Y'C'_BC'_R$)/12-bit	120 frames progressive 120/1.001 frames progressive 100 frames progressive 96 frames progressive 96/1.001 frames progressive
Rec. ITU-R BT.2100	1920 x 1080	4:2:2 ($Y'C'_BC'_R$)/12-bit 4:2:2:4 ($Y'C'_BC'_R$+A*3)/12-bit 4:2:2 (IC_TC_P*4)/12-bit 4:2:2:4 (IC_TC_P*4+A*3)/12-bit 4:2:0 ($Y'C'_BC'_R$)/12-bit 4:2:0 (IC_TC_P*4)/12-bit	120 frames progressive 120/1.001 frames progressive 100 frames progressive
SMPTE ST 2048-1	2048 x 1080*2	4:2:2 ($Y'C'_BC'_R$)/12-bit	120 frames progressive 120/1.001 frames progressive

		4:2:0 ($Y'C'_BC'_R$)/12-bit	100 frames progressive
		4:2:2:4 ($Y'C'_BC'_R$+A[*3])/12-bit	96 frames progressive
			96/1.001 frames progressive

Notes:

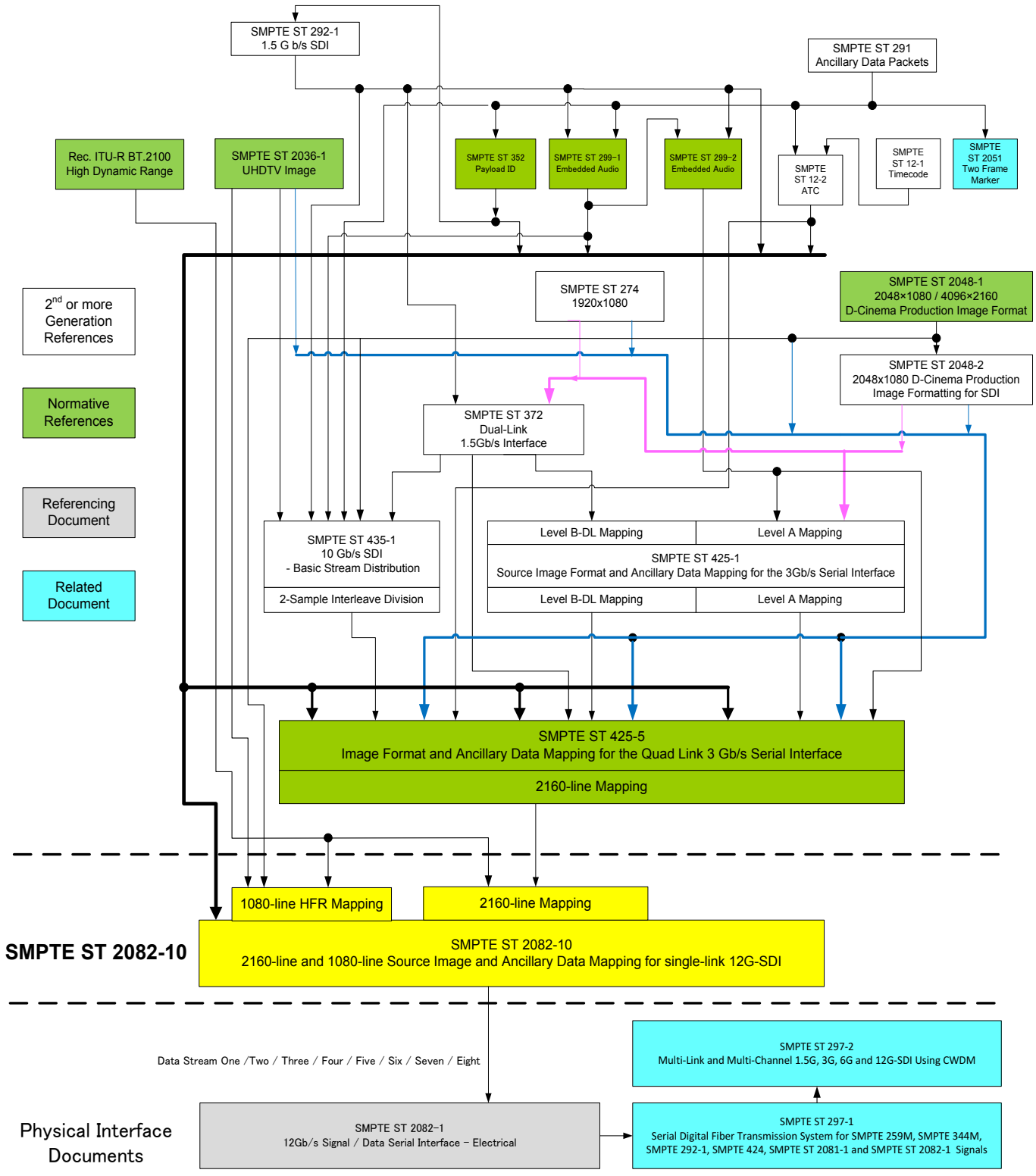
*1 In this image format R′G′B′ indicates either R′G′B′ or $R'_{FS}G'_{FS}B'_{FS}$.

*2 This is the maximum pixel array, the active image may not fill the maximum array.

*3 Definition of the A channel is application-dependent. An auxiliary component signal designated A or Alpha may optionally accompany the R′G′B′, $R'_{FS}G'_{FS}B'_{FS}$, $Y'C'_BC'_R$ or IC_TC_P video signal. Interfaces containing the auxiliary component are denoted as R′G′B′+A, $Y'C'_BC'_R$ +A and IC_TC_P + A. In the cases when the A channel is used for non-picture data, the payload is constrained to 8-bit words maximum

*4 In accordance with Recommendation ITU-R BT.2100, IC_TC_P sampling is only applied to High Dynamic Range (HDR) progressive image formats.

2.2 SMPTE ST 2082-10 Document Roadmap



3 SMPTE ST 2082-11 – 4320-line and 2160-line Source Image and Ancillary Data Mapping for Dual-link 12G-SDI

This standard defines several mapping modes for the carriage of 4320-line and 2160-line image formats and associated ancillary data into a Dual-link 12 Gb/s [nominal] SDI bit-serial interface as follows:

- **MODE 1:** 4320-line Y′C′$_B$C′$_R$ 4:2:2 and 4:2:0 10-bit image formats and ancillary data on a Dual-link 12 Gb/s [nominal] SDI bit-serial interface
- **MODE 2:** 2160-line R′G′B′, Y′C′$_B$C′$_R$ 4:4:4(:4) 10-bit and 4:4:4 12-bit image formats and ancillary data on a Dual-link 12 Gb/s [nominal] SDI bit-serial interface
- **MODE 3:** 2160-line Y′C′$_B$C′$_R$ 4:2:2 and 4:2:0 10-bit Additional Frame Rate Source image formats and ancillary data on a Dual-link 12 Gb/s [nominal] SDI bit-serial interface

This standard also defines the carriage of ancillary data, and the SMPTE ST 352 payload ID's for the dual-link 12Gb/s SDI interface.

3.1 SMPTE ST 2082-11 Supported Image Formats

UHDTV2 Production			
Reference SMPTE Standard	Image Format	Signal Format Sampling Structure/pixel Depth	Frame Rate Hz
ST 2036-1	7680 × 4320	4:2:2 (Y′C′$_B$C′$_R$), 4:2:0 (Y′C′$_B$C′$_R$)/10-bit	24/1.001, 24, 25, 30/1.001 and 30 Progressive
UHDTV1 and 4K Digital Cinematography Production			
Reference SMPTE Standard	Image Format	Signal Format Sampling Structure/pixel Depth	Frame Rate Hz
ST 2036-1	3840 × 2160	4:4:4 (R′G′B′), 4:4:4:4 (R′G′B′ +A)/10-bit	50, 60/1.001 and 60 Progressive
ST 2048-1	4096 × 2160[*2]	4:4:4 (R′G′B′[*1]), 4:4:4:4 (R′G′B′[*1]+A)/10-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
ST 2036-1	3840 × 2160	4:4:4 (Y′C′$_B$C′$_R$), 4:4:4:4 (Y′C′$_B$C′$_R$+A)/10-bit	50, 60/1.001 and 60 Progressive
ST 2048-1	4096 × 2160[*2]	4:4:4 (Y′C′$_B$C′$_R$), 4:4:4:4 (Y′C′$_B$C′$_R$+A)/10-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
ST 2036-1	3840 × 2160	4:4:4 (R′G′B′)/12-bit	50, 60/1.001 and 60 Progressive
ST 2048-1	4096 × 2160[*2]	4:4:4 (R′G′B′[*1])/12-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive

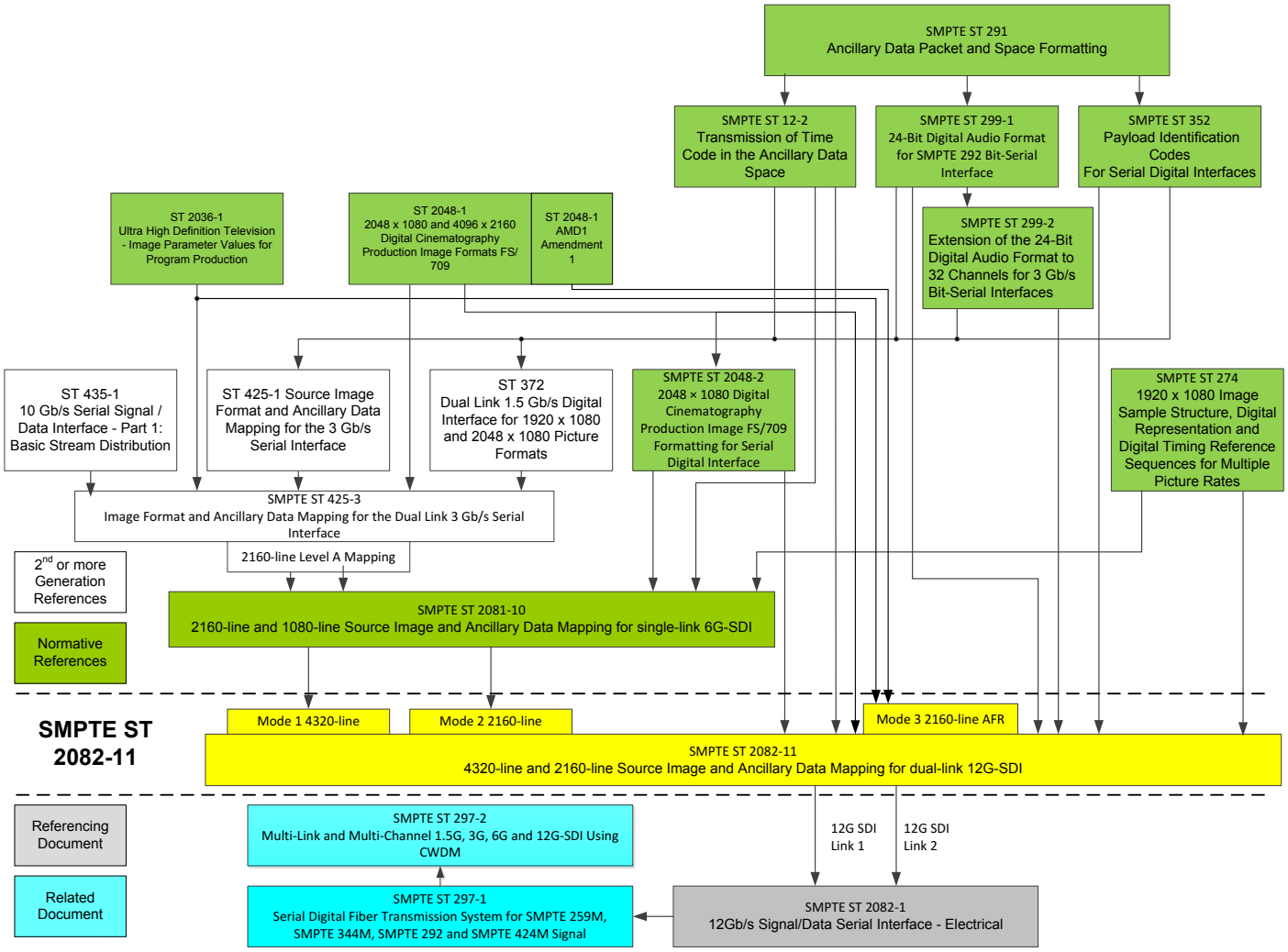
ST 2036-1	3840 × 2160	4:4:4 ($Y'C'_BC'_R$)/12-bit	50, 60/1.001 and 60 Progressive
ST 2048-1	4096 × 2160[*2]	4:4:4 ($Y'C'_BC'_R$)/12-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
ST 2036-1	3840 × 2160	4:2:2 ($Y'C'_BC'_R$)/12-bit 4:2:0 ($Y'C'_BC'_R$)/12-bit	50, 60/1.001 and 60 Progressive
ST 2048-1	4096 × 2160[*2]	4:2:2 ($Y'C'_BC'_R$)/12-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
ST 2048-1	4096 × 2160[*2]	4:2:2:4 ($Y'C'_BC'_R$+A)/12-bit	48/1.001, 48, 50, 60/1.001 and 60 Progressive
UHDTV1 and 4K Digital Cinematography Production AFR			
Reference SMPTE Standard	Image Format	Signal Format Sampling Structure/pixel Depth	Additional Frame Rates (AFR) Hz
ST 2036-1	3840 x 2160	4:2:2 ($Y'C'_BC'_R$)/10-bit 4:2:0 ($Y'C'_BC'_R$)/10-bit	120 progressive
			120/1.001 progressive
			100 progressive
ST 2048-1	4096 x 2160	4:2:2 ($Y'C'_BC'_R$)/10-bit	120 progressive
			120/1.001 progressive
			100 progressive
			96 progressive
			96/1.001 progressive

Notes:

[*1] In this image format R′G′B′ indicates either R′G′B′ or $R'_{FS}G'_{FS}B'_{FS}$. An additional Color VANC packet to describe the FS characteristics is defined by SMPTE ST 2048-1.

[*2] This is the maximum pixel array, the active image may not fill the maximum array.

3.2 SMPTE ST 2082-11 Document Roadmap



4 SMPTE ST 2082-12 – 4320-line and 2160-line Source Image and Ancillary Data Mapping for Quad-link 12G-SDI

This standard defines several mapping modes for the carriage of 4320-line and 2160-line image formats and associated ancillary data into a Quad-link 12 Gb/s [nominal] SDI bit-serial interface as follows:

- **MODE 1:** 4320-line Source image formats and ancillary data into a Quad-link 12 Gb/s [nominal] SDI bit-serial interface
- **MODE 2:** 2160-line $Y'C'_BC'_R$ or $R'G'B'$ 4:4:4:4 10-bit or 4:4:4 10-bit or 12-bit Additional Frame Rate (AFR) Source image formats and ancillary data into a Quad-link 12 Gb/s [nominal] SDI bit-serial interface

This standard also defines the carriage of ancillary data, and the SMPTE ST 352 payload ID's for the quad-link 12Gb/s SDI interface.

4.1 SMPTE ST 2082-12 Supported Image Formats

<table>
<tr><th colspan="4">UHDTV2 Production</th></tr>
<tr><td>Reference SMPTE Standard</td><td>Image Format</td><td>Signal Format Sampling Structure/pixel Depth</td><td>Frame Rate
Hz</td></tr>
<tr><td>ST 2036-1</td><td>7680 x 4320</td><td>4:2:2 (Y′C′_BC′_R),
4:2:0 (Y′C′_BC′_R)/10-bit</td><td>50, 60/1.001 and 60 Progressive</td></tr>
<tr><td>ST 2036-1</td><td>7680 x 4320</td><td>4:4:4 (R′G′B′)/10-bit</td><td rowspan="5">24/1.001, 24, 25, 30/1.001 and 30 Progressive</td></tr>
<tr><td>ST 2036-1</td><td>7680 x 4320</td><td>4:4:4 (Y′C′_BC′_R)/10-bit</td></tr>
<tr><td>ST 2036-1</td><td>7680 x 4320</td><td>4:4:4 (R′G′B′)/12-bit</td></tr>
<tr><td>ST 2036-1</td><td>7680 x 4320</td><td>4:4:4 (Y′C′_BC′_R)/12-bit</td></tr>
<tr><td>ST 2036-1</td><td>7680 x 4320</td><td>4:2:2 (Y′C′_BC′_R)/12-bit
4:2:0 (Y′C′_BC′_R)/12-bit</td></tr>
<tr><th colspan="4">UHDTV1 and 4K Digital Cinematography Production AFR</th></tr>
<tr><td>Reference SMPTE Standard</td><td>Image Format</td><td>Signal Format Sampling Structure/pixel Depth</td><td>Frame Rate
Hz</td></tr>
<tr><td rowspan="3">ST 2036-1</td><td rowspan="3">3840 x 2160</td><td rowspan="3">4:4:4 (R′G′B′)/10-bit
4:4:4:4 (R′G′B′+A)/10-bit
4:4:4 (Y′C′_BC′_R)/10-bit
4:4:4:4 (Y′C′_BC′_R+A)/10-bit</td><td>120 frames progressive</td></tr>
<tr><td>120/1.001 frames progressive</td></tr>
<tr><td>100 frames progressive</td></tr>
<tr><td rowspan="5">ST 2048-1</td><td rowspan="5">4096 x 2160*2</td><td rowspan="5">4:4:4 (R′G′B′*1),
4:4:4:4 (R′G′B′*1+A)/10-bit,
4:4:4 (Y′C′_BC′_R),
4:4:4:4 (Y′C′_BC′_R+A)/10-bit</td><td>120 frames progressive</td></tr>
<tr><td>120/1.001 frames progressive</td></tr>
<tr><td>100 frames progressive</td></tr>
<tr><td>96 frames progressive</td></tr>
<tr><td>96/1.001 frames progressive</td></tr>
<tr><td rowspan="3">ST 2036-1</td><td rowspan="3">3840 x 2160</td><td rowspan="3">4:4:4 (R′G′B′)/12-bit,
4:4:4 (Y′C′_BC′_R)/12-bit</td><td>120 frames progressive</td></tr>
<tr><td>120/1.001 frames progressive</td></tr>
<tr><td>100 frames progressive</td></tr>
</table>

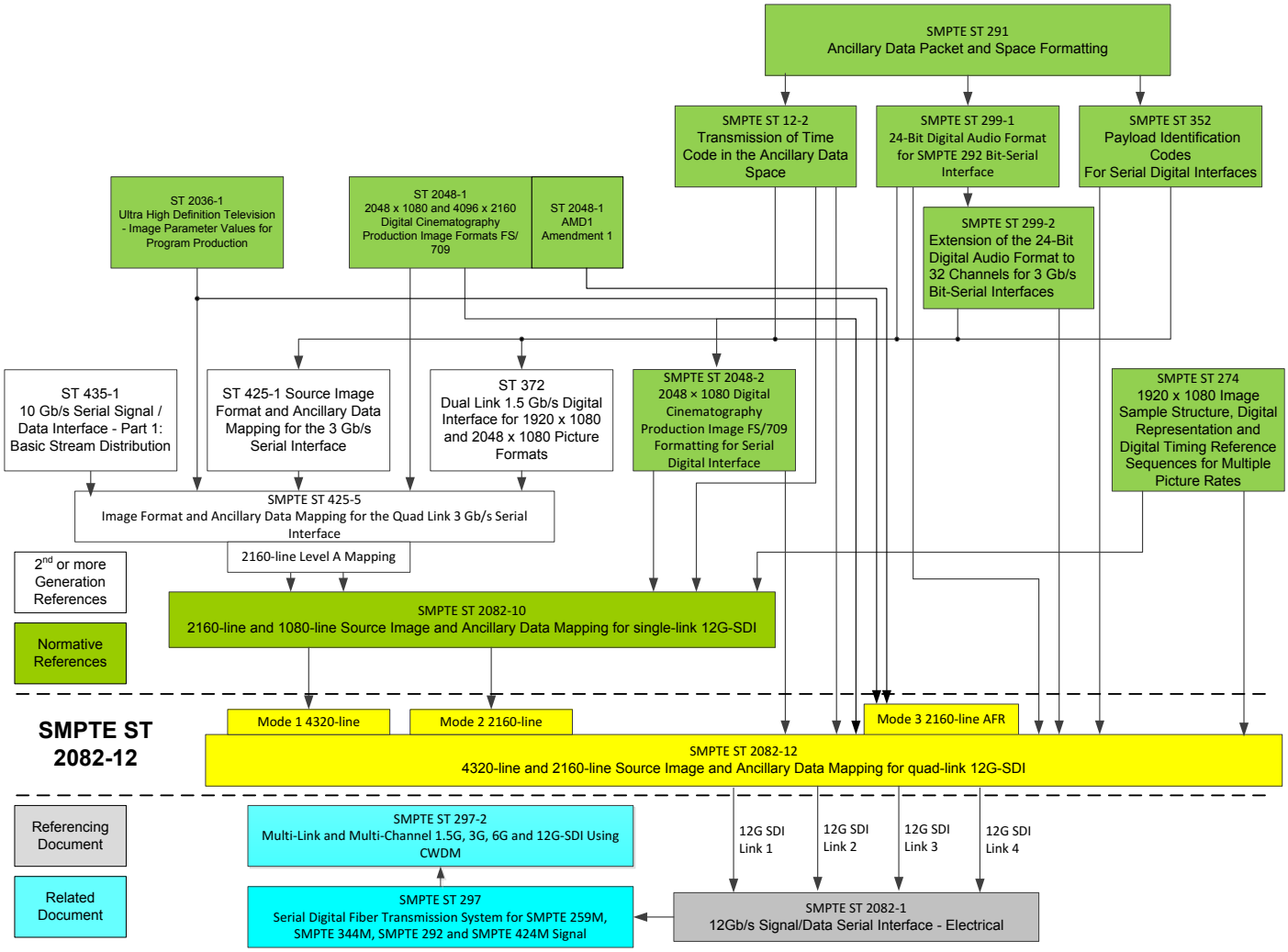
ST 2048-1	4096 x 2160[*2]	4:4:4 (R′G′B′[*1])/12-bit, 4:4:4 (Y′C′$_B$C′$_R$)/12-bit	120 frames progressive
			120/1.001 frames progressive
			100 frames progressive
			96 frames progressive
			96/1.001 frames progressive
ST 2036-1	3840 x 2160	4:2:2 (Y′C′$_B$C′$_R$)/12-bit 4:2:0 (Y′C′$_B$C′$_R$)/12-bit	120 frames progressive
			120/1.001 frames progressive
			100 frames progressive
ST 2048-1	4096 x 2160[*2]	4:2:2 (Y′C′$_B$C′$_R$)/12-bit 4:2:0 (Y′C′$_B$C′$_R$)/12-bit 4:2:2:4 (Y′C′$_B$C′$_R$+A)/12-bit	120 frames progressive
			120/1.001 frames progressive
			100 frames progressive
			96 frames progressive
			96/1.001 frames progressive

Notes:

[*1] In this image format R′G′B′ indicates either R′G′B′ or R′$_{FS}$G′$_{FS}$B′$_{FS}$. An additional Color VANC packet to describe the FS characteristics is defined by SMPTE ST 2048-1.

[*2] This is the maximum pixel array, the active image may not fill the maximum array.

4.2 SMPTE ST 2082-12 Document Roadmap



5 SMPTE ST 2082-30 – Transport of Multiple 6Gb/s, 3Gb/s or 1.5Gb/s signals on a 12G-SDI link

This Standard defines the combination of HD-SDI signals, 3G-SDI signals and 6G-SDI signals into a 12G-SDI interface.

- **MODE 1:** Carriage of two SMPTE ST 2081-10 6G-SDI signals on a 12G-SDI 10-bit interface as defined in section 7 Single-link 12G-SDI 10-bit Multiplex

- **MODE 2:** Carriage of four SMPTE ST 425-1 3G-SDI signals on a 12G-SDI 10-bit interface as defined in section 7 Single-link 12G-SDI 10-bit Multiplex

- **MODE 3:** Carriage of eight SMPTE ST 292-1 HD-SDI signals on a 12G-SDI 10-bit interface as defined in section 7 Single-link 12G-SDI 10-bit Multiplex

This standard also defines the carriage of the SMPTE ST 352 payload ID's for the single-link 12Gb/s SDI interface.

5.1 SMPTE ST 2082-30 Document Road Map